TABLE 1. CLASSIFICATION OF MOTORS—(Concluded)

CURRENT	TYPE	SPEED CHARACTERISTICS	FULL VOLTAGE		HP RANGE	TYPE OF APPLICATION SEE FOOTNOTE*
			STARTING TORQUE	STARTING CURRENT		
POLYPHASE	23. Wound Rotor, Slip, Ring, External Secondary Resistance	Variable	High	Low	All	(*a*) Fans and (*b*) Centrifugal Pumps
	24. Capacitor High Torque Tapped Winding	Variable	High	Normal	Medium Low	(*a*) Fans, belt
	25. Capacitor Low Torque Tapped Winding	Variable	Low	Medium	Medium Low	(*d*) Fans, direct
SINGLE PHASE	26. Capacitor High Torque Transformer Adjustment	Variable	Low	Low	Fractional	(*d*) Fans
	27. Capacitor Low Torque Transformer Adjustment	Variable	Low	Low	Fractional	(*d*) Fans
	28. Split Phase Regrouped Poles	Constant	Normal	Normal	Fractional	(*d*) Fans

Often where the central station requires current limiting starting equipment for the normal torque, normal starting current motor, it is advisable to use the normal torque low starting current multispeed motor.

High slip polyphase motors may be used for adjustable varying speed drives in a manner similar to that described for capacitor motors, with either a transformer speed regulator or tapped motor windings.

It is apparent from these motor characteristics that a squirrel cage motor may be selected for operating any air conditioning and allied equipment.

Automatic start induction motors are constructed with two windings on the rotor, one of which is a high resistance, squirrel cage winding used in starting and gives a high starting torque approximately the same as the high torque, squirrel cage. A centrifugal mechanism within the motor switches to the second low resistance winding when the motor comes up to speed, thus obtaining running characteristics equal to the normal torque, normal current squirrel cage motor. The power factor of the starting current is high.

Slip ring wound rotor motors are built for two classes of service, constant speed and adjustable variable speed. The motors are identical in each case and use the same primary control, the only difference being in the secondary control.

Slip ring motors for constant speed service are used where high starting torque with low starting current is required for bringing heavy loads up to speed. The resistance is in the secondary or rotor circuit, only when starting, and is short circuited when the motor is up to speed.

For adjustable varying speed service, part or all of the secondary controller resistance is in the circuit whenever the motor is operating below full speed. The speed obtained with a given resistance in the secondary circuit is dependent on, and changes with the load on the motor. The horsepower developed by the motor is approximately proportional to the speed, whereas the power required by the motor is practically the same at reduced speed as at full speed, hence the efficiency at reduced speeds is much lower than at full speed.

Synchronous motors are ordinarily used only where there is a need for, or advantage in, obtaining power factor correction. It is necessary to consider each application as a special case which must be individually engineered, since for satisfactory operation, the combined moment of inertia of the compressor fly wheel and motor rotor must be correctly established.

The general classification of motors used for heating, ventilation and air conditioning is shown in Table 1.

SPECIAL APPLICATIONS

A few applications of motors may require special constructions such as splash proof, explosion proof, fully enclosed, and self-ventilated to meet hazardous or special duty conditions. These requirements are frequently encountered in certain industrial applications, in which cases it is necessary to select the motors from the viewpoint of service conditions, as well as the required operating characteristics to meet the demands of the machines being driven.

CONTROL EQUIPMENT FOR MOTORS

In selecting control for alternating and direct current motors it is necessary to determine whether the installation is to be operated by manual or automatic control. The available controls and the function of each group of apparatus may be outlined as follows:

1. Manual Control:
   - *a.* To establish current.
     - (1) Snap switch.
     - (2) Knife switch.
     - (3) Manually operated contactor.
     - (4) Drum switch.
   - *b.* Establish current and add overload protective device.
     - (1) Snap switch with overload element.
     - (2) Knife switch with fuse or thermal cutout.
     - (3) Manual contactor with overload protective device; also reduced voltage starting compensator.
     - (4) Drum switch with overload protection.
   - *c.* Establish current and add overload and low voltage protective devices.
     - (1) Not used.
     - (2) Not used.